Insight into Free-Living Honey Bee Population in Serbia's Capital – A COLOSSal Walk around Belgrade

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Background

In the past years, a surprisingly large number of free-living honey bee colonies was recorded in Belgrade, capital of Serbia (Bila Dubaić et al., 2021). Since there are no public city services that citizens could turn to if they notice a colony of free-living honey bees in their proximity, a large portion of such cases are reported to beekeepers. Owing mostly to the engagement of one Belgrade beekeeper, scientists of the Faculty of Biology University of Belgrade obtained a large set of data on free-living honey bees in Belgrade. The collected data covers a period of 7 years (2011–2017) and, after elimination of dubious and duplicated reports, the number of recorded swarms and colonies exceeded 1300 (Figure 1).

Why are Free-Living Honey Bees Important?

After massive honey bee die-off throughout Eurasia and North America due to the spread of ectoparasite *Varroa destructor* (Le Conte et al., 2010; Potts et al., 2010), it was generally thought that untreated colonies could not survive (Büchler et al., 2010; Oleksa et al., 2013), or if they do they last 1–3 years. Recently however, there are reports of longer survival of free-living colonies (De Jong & Soares 1997; Fries et al., 2006; Le Conte et al., 2007, 2020; Locke et al., 2012; Locke & Fries 2011; Seeley 2007, 2017; Seeley et al., 2015). Apparently, far from beekeeping management practices, also in Europe western honey bees are being able to create a host-parasite equilibrium (Blacquiere & Panziera 2018; Kohl et al., 2022; McMullan 2018). Understanding the factors that enable them to survive despite *Varroa* (and other environmental stressors) is very important for the future health of *Apis mellifera* populations and sustainable beekeeping.

The scientific group leading the project "Serbhiwe" from the Institute of Biological Research "Siniša Stanković", visited and sampled ~50 free-living colonies (Figure 2) from highly urbanized

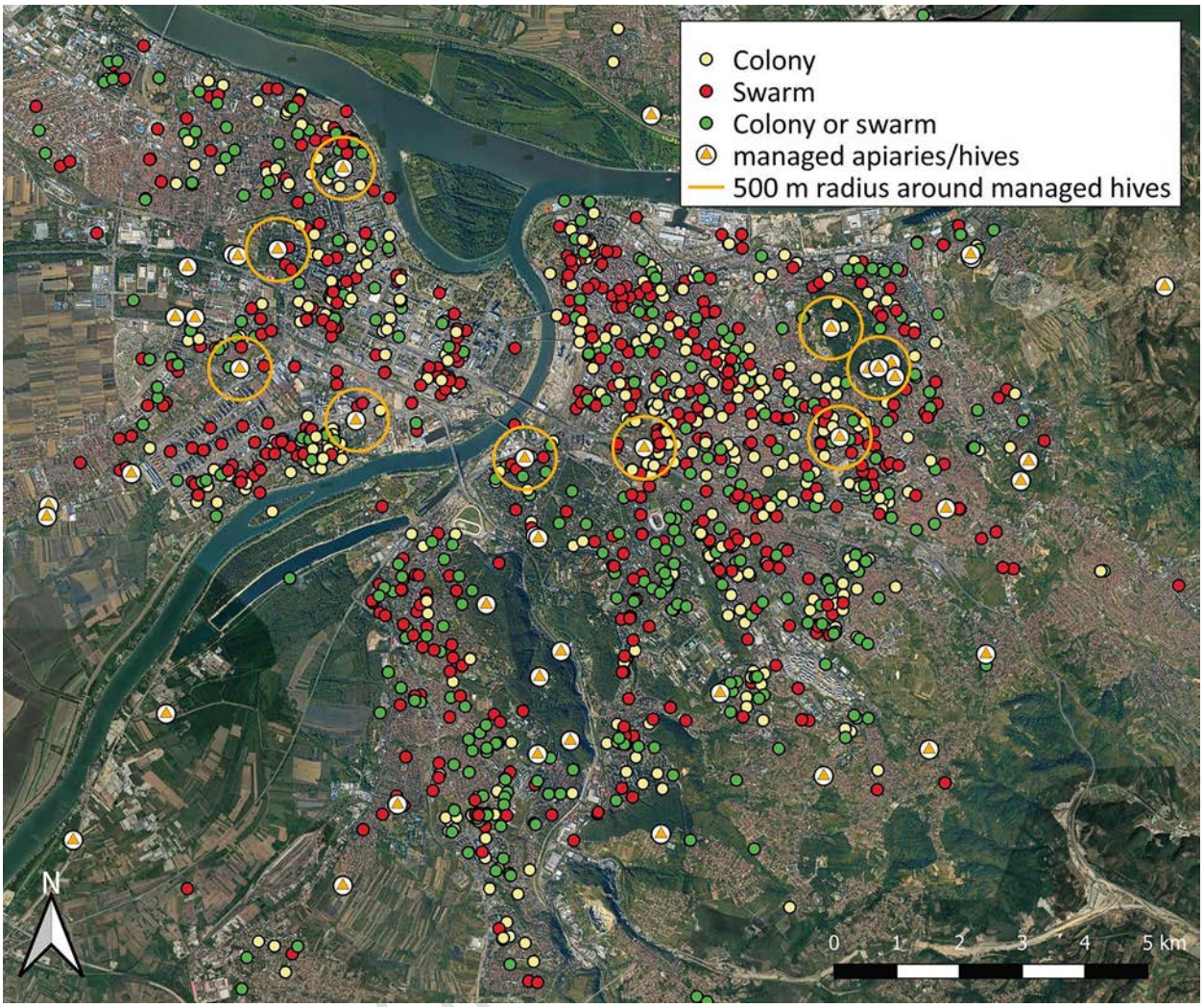

Figure 1. Georeferenced occurrences of free-living honey bee colonies and swarms in Belgrade in the period of 2011–2017. Three different categories of reports (nesting colonies, swarms, and ambiguous or unspecified reports – the latter could be either a colony or a swarm) are shown in different colored dots. Managed apiaries (or individual hives) that surround the urban core city area are also shown – yellow triangles with a circular 'buffer zone' of 500 m radius.

areas of Belgrade during 2020 and 2021. Genetic analysis of mitochondrial *tRNAleu-cox2* intergenic region and 14 microsatellite loci, that also included samples from managed colonies in the area, confirmed that Belgrade's free-living honey bees are unique, with several unique haplotypes detected and higher values for different parameters of genetic diversity (Bila Dubaić et al., 2021; Patenkovic et al., 2022). This confirmed that this population is not the result of a

regular influx of escaped swarms from surrounding managed apiaries, especially since molecular analyses showed that feral colonies are more related among themselves than with managed colonies.

Figure 2. One of the free-living colonies in the center of Belgrade observed during 2020, living inside a hollow tree in a city park (photo JBD).

A COLOSSal Walk around Belgrade Scouting for SURVIVORS' Honey Bee Colonies

The *Survivors Task Force* (Dall'Olio et al., 2022) of the international research association COLOSS that gathers scientists, researchers, students, veterinarians and agriculture specialists focused on improving the well-being of honey bees, organized a Belgrade *city walk tour* to visit

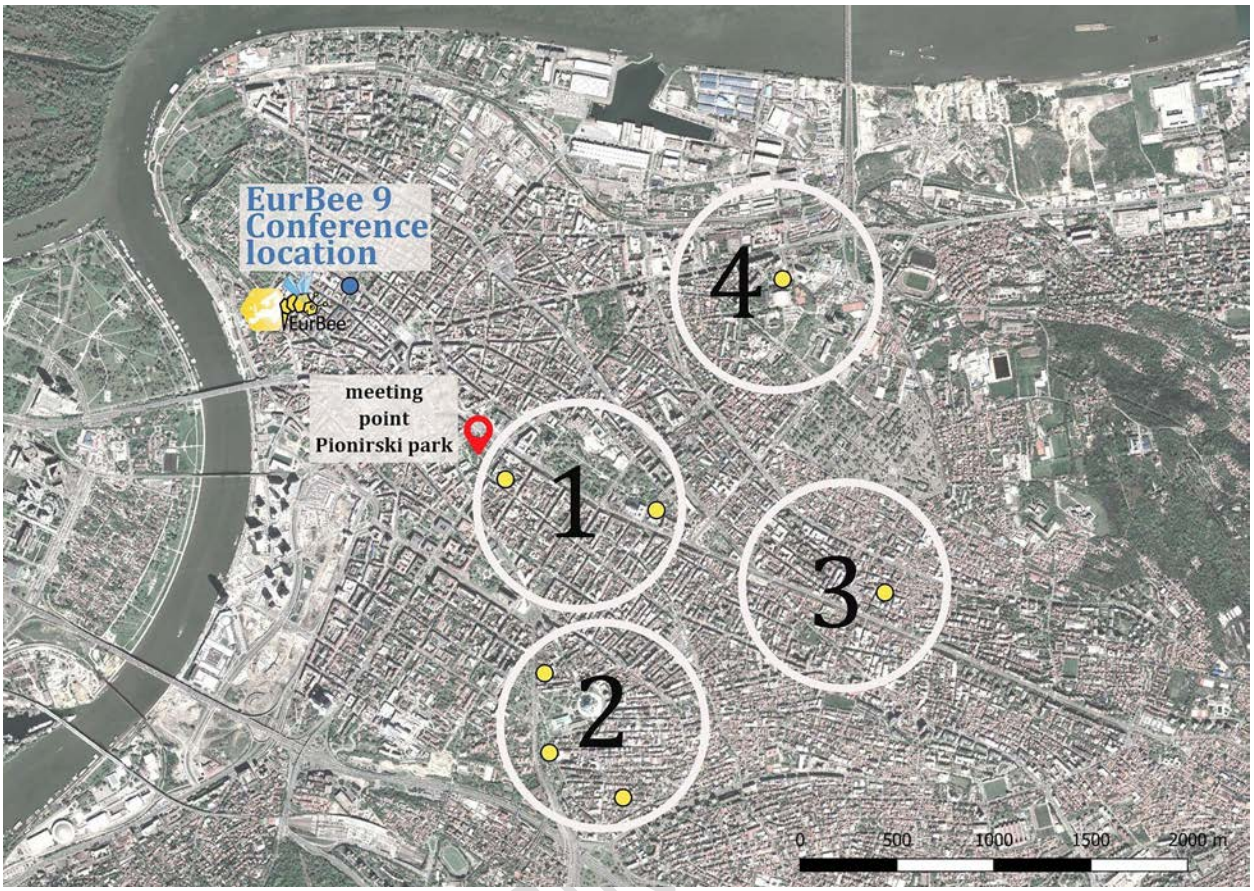

Figure 3. Planned route for Belgrade city walk – yellow points show free-living colonies that were visited and observed. Numbers 1–4 indicate the order of visiting locations.

and observe some of the free-living colonies around the city (Figure 3). The walk was organized as a social event of the *IX European Congress of Apidology* (*Eurbee 9*), which was held in September 2022 in Belgrade, free of charge and open to all conference participants and accompanying people. The tour was locally organized and guided by Serbian researchers that studied free-living colonies in detail (JBD and SD) and Survivors Task Force members. Registration for the walk was obligatory, and since the interest was high, two walks were realized on two separate days (Figures 4 and 5). On the first day, despite bad weather conditions not suitable for honey bees (cloudy and cold 14 °C, with light rain periods), participants were able to see activity around the occupied cavities at 2 locations. At the other 5 locations it was possible to observe many dead worker honey bees on the ground, and black markings around the entrance of the occupied cavities (Figure 6). Underneath some of the

Figure 4. First day of the tour – group observing one of the free-living colonies in the private garden of one of the citizen scientists who firstly reported it back in 2013 (Photo Aleksandar Mišić).

Figure 5. Second day of the tour – group observing one of the free-living colonies living inside Kalemegdan fortress walls (photo: Danilo Bevk).

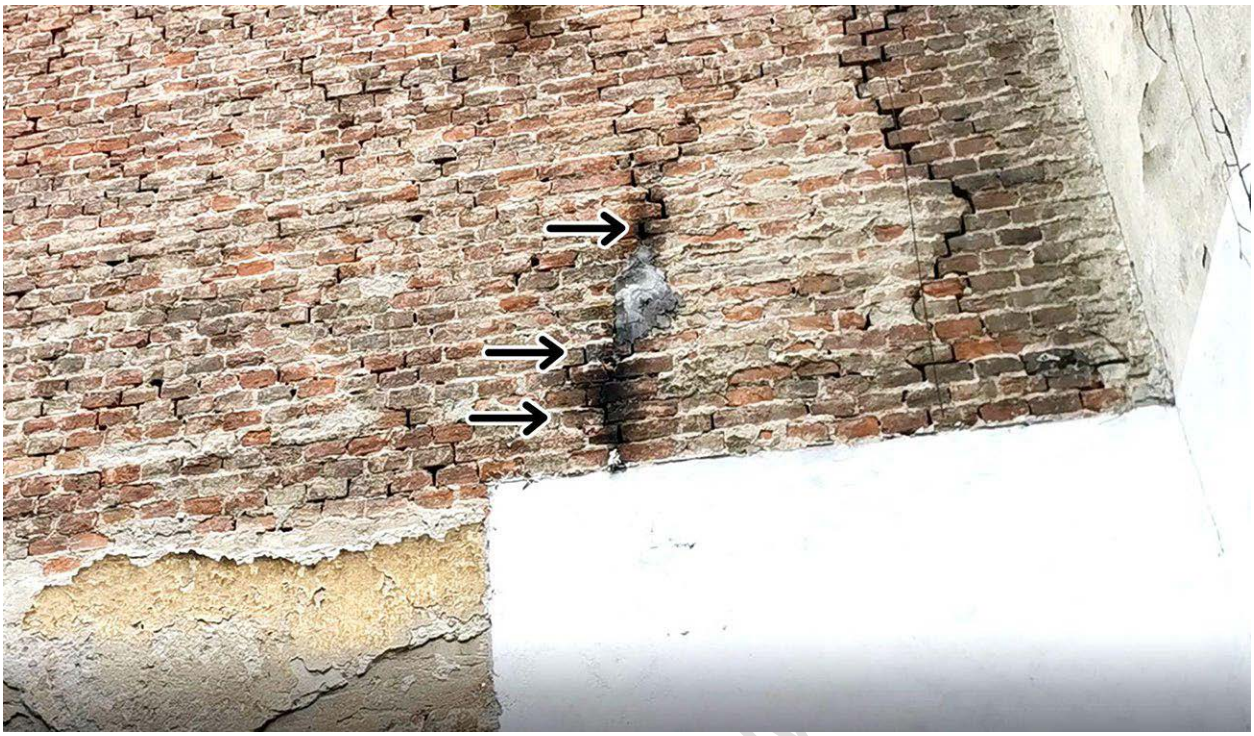

Figure 6. This old chimney, which is not in use, served as a cavity where bees have been living for years – this colony was first reported in 2011. Black markings are visible around the multiple entrances along the cavity (photo: JBD).

colonies participants spotted several slowly moving worker honey bees with obvious signs of deformed wing virus (Figure 7), that were probably thrown out of the hive by healthy workers. Despite the colonies' activities were not as high as desired, the walk was enriched by the local custodians, citizens living in the nests' proximity and regularly monitoring them, sharing their enthusiastic testimonies with all participants.

On the second day, weather conditions were more suitable (cloudy but warm 19 °C, no rain or strong wind) and bee activity was observed on 5 out of 7 visited locations (Video 1, supplementary material).

Conclusions

The beautiful Serbian capital hosting the largest European conference of Apidology was the perfect combination for COLOSS Survivors Task Force to witness “in person” some of the outcomes of Bila Dubaić et al. (2021) paper.

Figure 7. One of the workers underneath the opening of the free-living colony, with signs of deformed wing virus (photo: JBD).

Despite the already dense scientific program offered by Eurbee9, both tours were attended overall by more than 20 people from 13 different countries: during the walks participants exchanged their knowledge and experience on the topic of free-living honey bees, discussed possible monitoring practices, how to achieve successful long term engagement of custodians and shared ideas for future investigations.

Several participants who for the first time visited Belgrade, confirmed the initiative was also a great way to get familiar with the city, especially after the long break from meetings due to the COVID-19 pandemic.

Importance of free-living honey bees is slowly being recognized by the scientific community which leads to the growing interest to study these self-managing populations (Dall'Olio & Garrido 2021). In addition, the naturally occurring habitats for honey bees are diminishing due to the habitat degradation and this pressure forces them to seek for another type of habitat. It turns out that the urban environments with their existing cavities present an attractive alternative. Due to these factors, it is likely that Belgrade-like scenarios might be found in other cities or in their outskirts. The study by Bila Dubaić et al. (2021) as well as this walk showed that citizens are able to provide an invaluable contribution for scouting and monitoring: also for this reason the Survivors task force established Honey Bee Watch (honeybeewatch.com) an independent citizen science initiative to study free-living colonies… so, help us fill the honeybeewatch.com map and the next COLOSSal Survivors walk might happen at your place!

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Authors Contributions

All three authors contributed equally to the publication.

Disclosure Statement

No potential conflict of interest was reported by the authors.

Ethics Approval and Consent to Participate

No requirements or permissions are needed for this work.

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Supplementary Material

Supplementary Video 1 is available via the "Supplementary" tab on the article's online page (https://doi.org/10.1080/0005772X.2022.2151721).

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